CCGPS Frameworks Student Edition

Mathematics

CCGPS Coordinate Algebra
Unit 6: Connecting Algebra and Geometry Through Coordinates

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"Making Education Work for All Georgians"

Unit 6
Connecting Algebra and Geometry Through Coordinates

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OVERVIEW

In this unit students will:

- prove the slope relationship that exists between parallel lines and between perpendicular lines and then use those relationships to write the equations of lines.
- extend the Pythagorean Theorem to the coordinate plan.
- develop and use the formulas for the distance between two points and for finding the point that partitions a line segment in a given ratio.
- revisit definitions of polygons while using slope and distance on the coordinate plane.
- use coordinate algebra to determine perimeter and area of defined figures.

Although the units in this instructional framework emphasize key standards and big ideas at specific times of the year, routine topics such as estimation, mental computation, and basic computation facts should be addressed on an ongoing basis. Ideas related to the eight practice standards should be addressed constantly as well. To assure that this unit is taught with the appropriate emphasis, depth, and rigor, it is important that the tasks listed under “Evidence of Learning” be reviewed early in the planning process. A variety of resources should be utilized to supplement this unit. This unit provides much needed content information, but excellent learning activities as well. The tasks in this unit illustrate the types of learning activities that should be utilized from a variety of sources.

STANDARDS ADDRESSED IN THIS UNIT

Mathematical standards are interwoven and should be addressed throughout the year in as many different units and activities as possible in order to emphasize the natural connections that exist among mathematical topics.

KEY STANDARDS ADDRESSED

Use coordinates to prove simple geometric theorems algebraically.

MCC9-12.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically. For *example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*

MCC9-12.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

MCC9-12.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

MCC9-12.G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

1. **Make sense of problems and persevere in solving them.** High school students start to examine problems by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. By high school, students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. They check their answers to problems using different methods and continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. **Reason abstractly and quantitatively.** High school students seek to make sense of quantities and their relationships in problem situations. They abstract a given situation and represent it symbolically, manipulate the representing symbols, and pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Students use quantitative reasoning to create coherent representations of the problem at hand; consider the units involved; attend to the meaning of quantities, not just how to compute them; and know and flexibly use different properties of operations and objects.

3. **Construct viable arguments and critique the reasoning of others.** High school students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. High school students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. High school students learn to determine domains to which an argument applies, listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. **Model with mathematics.** High school students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. High school students making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. **Use appropriate tools strategically.** High school students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. High school students should be sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. They are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. **Attend to precision.** High school students try to communicate precisely to others by using clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, specifying units of measure, and labeling axes

to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. **Look for and make use of structure.** By high school, students look closely to discern a pattern or structure. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y. High school students use these patterns to create equivalent expressions, factor and solve equations, and compose functions, and transform figures.

8. **Look for and express regularity in repeated reasoning.** High school students notice if calculations are repeated, and look both for general methods and for shortcuts. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, derive formulas or make generalizations, high school students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Connecting the Standards for Mathematical Practice to the Standards for Mathematical Content

The Standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics should engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years. Designers of curricula, assessments, and professional development should all attend to the need to connect the mathematical practices to mathematical content in mathematics instruction.

The Standards for Mathematical Content are a balanced combination of procedure and understanding. Expectations that begin with the word “understand” are often especially good opportunities to connect the practices to the content. Students who do not have an understanding of a topic may rely on procedures too heavily. Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, a missing mathematical knowledge effectively prevents a student from engaging in the mathematical practices.

In this respect, those content standards which set an expectation of understanding are potential “points of intersection” between the Standards for Mathematical Content and the

Standards for Mathematical Practice. These points of intersection are intended to be weighted toward central and generative concepts in the school mathematics curriculum that most merit the time, resources, innovative energies, and focus necessary to qualitatively improve the curriculum, instruction, assessment, professional development, and student achievement in mathematics.

RELATED STANDARDS ADDRESSED

MCC9-12.G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

MCC9-12.A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

ENDURING UNDERSTANDINGS

- Algebraic formulas can be used to find measures of distance on the coordinate plane.
- The coordinate plane allows precise communication about graphical representations.
- The coordinate plane permits use of algebraic methods to obtain geometric results.

CONCEPTS/SKILLS TO MAINTAIN

It is expected that students will have prior knowledge/experience related to the concepts and skills identified below. It may be necessary to pre-assess in order to determine if time needs to be spent on conceptual activities that help students develop a deeper understanding of these ideas.

- simplifying radicals
- calculating slopes of lines
- graphing lines
- writing equations for lines

SELECTED TERMS AND SYMBOLS

The following terms and symbols are often misunderstood. These concepts are not an inclusive list and should not be taught in isolation. However, due to evidence of frequent difficulty and misunderstanding associated with these concepts, instructors should pay particular attention to them and how their students are able to explain and apply them.

The definitions below are for teacher reference only and are not to be memorized by

the students. Students should explore these concepts using models and real life examples. Students should understand the concepts involved and be able to recognize and/or demonstrate them with words, models, pictures, or numbers.

The websites below are interactive and include a math glossary suitable for high school. **Note – At the elementary level, different sources use different definitions. Please preview any website for alignment to the definitions given in the frameworks.**

http://www.teachers.ash.org.au/jeather/maths/dictionary.html
This web site has activities to help students more fully understand and retain new vocabulary (i.e. the definition page for *dice* actually generates rolls of the dice and gives students an opportunity to add them).

http://intermath.coe.uga.edu/dictnary/homepg.asp
Definitions and activities for these and other terms can be found on the Intermath website. Because Intermath is geared towards middle and high school.

- **Distance Formula:** d = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
- **Formula for finding the point that partitions a segment AB at the ratio of a:b from**

  A (x_1, y_1) **to B** (x_2, y_2)**:** $\left(\frac{a}{a+b}(x_2 - x_1) + x_1, \frac{a}{a+b}(y_2 - y_1) + y_1\right)$

New York Learning Task

Emily works at a building located on the corner of 9^{th} Avenue and 61^{st} Street in New York City. Her brother, Gregory, is in town on business. He is staying at a hotel at the corner of 9^{th} Avenue and 43^{rd} Street.

The streets of New York City were laid out in a rectangular pattern. In this part of town, Avenues run in a North-South direction and they are numbered from east to west, in other words the further east you go, the lower the number. That means the Avenues east of 9^{th} Ave. are 8^{th} Ave., 7^{th} Ave., etc. Streets run in an east-west direction. They increase in number as you proceed north. So, north of 41^{st} Street is 42^{nd} Street, then 43^{rd} Street, etc. The distance between the avenues is the same as the distance between the streets. All the blocks are approximately the same size.

1. Gregory called Emily at work, and they agree to meet for lunch. They agree to meet at a corner half way between Emily's work and Gregory's hotel. Then Gregory's business meeting ends early so he decides to walk to the building where Emily works.
   a. How many blocks does he have to walk? Justify your answer using a diagram on grid paper.

   b. After meeting Emily's coworkers, they walk back toward the corner restaurant. How many blocks must they walk? Justify your answer using your diagram.

2. After lunch, Emily has the afternoon off so she walks back to the hotel with Gregory before turning to go to her apartment. Her apartment is three blocks north and four blocks west of the hotel.

   a. At what intersection is her apartment building located?

   b. How many blocks south of the restaurant will they walk before Emily turns to go to her apartment?

   c. When Emily turns, what fraction of the distance from the restaurant to the hotel have the two of them walked? Express this fraction as a ratio of distance walked to distance remaining for Gregory.

3. Gregory and Emily are going to meet for dinner at a restaurant 5 blocks south of her apartment.

    a. At which intersection is the restaurant located?

    b. After dinner, they walk back towards her apartment, but stop at a coffee shop that is located three-fifths of the distance to the apartment. What is the location of the coffee shop?

Determine a procedure for finding a point that partitions a segment into a given ratio by investigating the situations that follow.

4. Find a point that partitions a directed line segment from $C(4, 3)$ to $D(10, 3)$ in a given ratio.
    a. Plot the points on a grid. (Notice that the points lie on the same horizontal line.) What is the distance between the points?

    b. Use the fraction of the total length of CD to determine the location of Point A which partitions the segment from C to D in a ratio of 5:1. What are the coordinates of A?

    c. Find point B that partitions a segment from C to D in a ratio of 1:2 by using the fraction of the total length of CD to determine the location of Point B. What are the coordinates of B?

5. Find the coordinates of Point X along the directed line segment YZ.

    a. If $Y(4, 5)$ and $Z(4, 10)$, find X so the ratio is of YX to XZ is 4:1.

    b. If $Y(4, 5)$ and $Z(4, 10)$, find X so the ratio is of YX to XZ is 3:2.

So far the situations explored have been with directed line segments that were either horizontal or vertical. Use the situations below to determine how the procedure used for Questions 4 and 5 changes when the directed line segment has a defined, nonzero slope.

6. Find the coordinates of Point *A* along a directed line segment from *C*(1, 1) to *D*(9, 5) so that *A* partitions *CD* in a ratio of 3:1. Since *CD* is neither horizontal nor vertical, the *x* and *y* coordinates have to be considered distinctly.

   a. Find the *x*-coordinate of *A* using the fraction of the horizontal component of the directed line segment (i.e., the horizontal distance between *C* and *D*).

   b. Find the *y*-coordinate of *A* using the fraction of the vertical component of the directed line segment (i.e., the vertical distance between *C* and *D*).

   c. What are the coordinates of *A*?

7. Find the coordinates of Point *A* along a directed line segment from *C*(3, 2) to *D*(5, 8) so that *A* partitions *CD* in a ratio of 1:1. Since *CD* is neither horizontal nor vertical, the *x* and *y* coordinates have to be considered distinctly.
   a. Find the *x*-coordinate of *A* using the fraction of the horizontal component of the directed line segment (i.e., the horizontal distance between *C* and *D*).

   b. Find the *y*-coordinate of *A* using the fraction of the vertical component of the directed line segment (i.e., the vertical distance between *C* and *D*).

   c. What are the coordinates of *A*?

8. Now try a few more …

   a. Find Point Z that partitions the directed line segment *XY* in a ratio of 5:3.
   X(–2, 6) and *Y*(–10, –2)

   b. Find Point *Z* that partitions the directed line segment *XY* in a ratio of 2:3.
   X(2, –4) and *Y*(7,2)

   c. Find Point *Z* that partitions the directed line segment *YX* in a ratio of 1:3.
   X(–2, –4) and *Y*(–7, 5) (Note the direction change in this segment.)

Back to Gregory and Emily….

9. When they finished their coffee, Gregory walked Emily back to her apartment, and then walked from there back to his hotel. How many blocks did he walk?

   a. If Gregory had been able to walk the direct path to the hotel from Emily's apartment, how far would he have walked? Justify your answer using your diagram.

   b. What is the distance Emily walks to work from her apartment?

   c. What is the length of the direct path between Emily's apartment and the building where she works? Justify your answer using your diagram.

Determine a procedure for determining the distance between points on a coordinate grid by investigating the following situations.

10. What is the distance between 5 and 7? 7 and 5? –1 and 6? 5 and –3?

11. Can you find a formula for the distance between two points, *a* and *b*, on a number line?

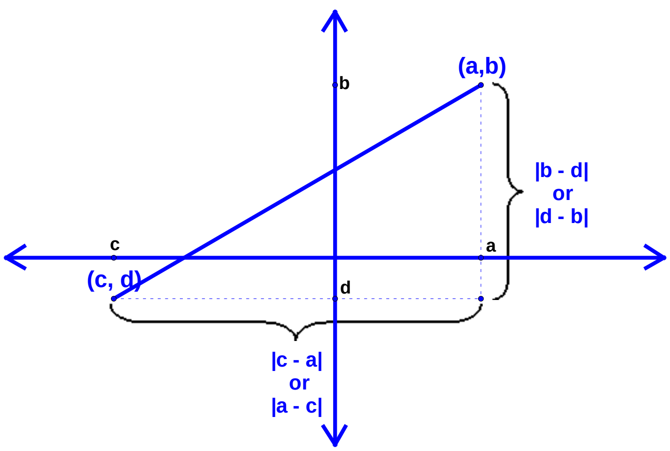
12. Using the same graph paper, find the distance between:

    (1, 1) and (4, 4)

    (–1, 1) and (11, 6)

    (–1, 2) and (2, –6)

13. Find the distance between points (a, b) and (c, d) shown below.



14. Using your solutions from 13 find the distance between the point (x_1, y_1) and the point (x_2, y_2). Solutions written in this generic form are often called formulas.

15. Do you think your formula would work for any pair of points? Why or why not?

Slopes of Special Lines Learning Task

Parallel Lines

1. On a *xy*-plane, graph lines l_1, l_2, and l_3, containing the given points. l_1 contains points $A(0,7)$ and $B(8,9)$; l_2 contains points $C(0,4)$ and $D(8,6)$; l_3 contains points $E(0,0)$ and $F(8,2)$. Make sure to carefully extend the lines past the given points.

   a. Find the distance between points *A* and *C* and between points *B* and *D*. What do you notice?

      What word describes lines l_1 and l_2?

   b. Find the distance between points C and E and between points D and F. What do you notice?

      What word describes lines l_2 and l_3?

   c. Find the distance between points A and E and between points B and F. What do you notice?

      What word describes lines l_1 and l_3?

   d. Now find the slopes of l_1, l_2, and l_3.

      What do you notice?

2. Now plot line l_4 through points $W(–1,3)$ and $X(–3,6)$ and line l_5 through points $Y(–2,1)$ and $Z(–4,4)$ carefully extending the lines across the *y*-axis.

   a. Use a ruler to measure the distance from *W* vertically to l_5. Then measure the distance from *X* vertically to l_5. What do you notice?

b. What word describes these lines?

c. Find the slope of each line. What do you notice?

3. What appears to be true about the slopes of parallel lines?

4. Follow the steps below to prove this true for all pairs of parallel lines.

a. Let the straight lines *l* and *m* be parallel. Sketch these on grid paper.
b. Plot any points *U* and *V* on line *l* and the point *W* so that *WV* is the rise and *UW* is the run of the slope of line *l*. (A straight line can have only one slope.)
That is, slope of line *l* is $\frac{\mathbf{WV}}{\mathbf{UW}}$.
c. Draw the straight line *UW* so that it intersects line m at point *X* and extends to include Point *Z* such that segment *YZ* is perpendicular to *UW*.
d. What is the slope of line *m*?

e. Line *UZ* is the ___________ of the lines *l* and *m*, so $\angle VUW$ and $\angle YXZ$are ______________ angles, so $\angle VUW$ ____ $\angle YXZ$.
f. Why is it true that, $\angle UWV \cong \angle YXZ$?

g. Now, $\boldsymbol{\Delta}$ *UWV* and $\boldsymbol{\Delta}$ *YXZ* are similar, so the ratio of their sides is proportional. Write the proportion that relates the vertical leg to the horizontal leg of the triangles.

h. Note that this proportion shows the slope of line *l* is the same as the slope of line *m*. Therefore, parallel lines have the same slope.

5. Write 2 equations that are parallel to the line $\boldsymbol{y = \frac{2}{3}x + 4}$.

6. Determine which of the following lines are parallel to $\mathbf{2x - 3y = 21}$. Explain why.

a. $y = -\frac{2}{3}x + 2$

b. $-6x + 9y = 12$

c. $\frac{1}{3}x + y = 6$

d. $2x + 3y = 7$

e. $3x - 4.5y = 1.5$

7. Line *m* is parallel to the line $\boldsymbol{y = -\frac{1}{2}x + 2}$ and contains the point (–6,1). What is the equation of Line *m* in slope-intercept form?

8. What is the equation of the line through (0, 5) and (–4, 8) which is parallel to the line that passes through (5, 2)?

Perpendicular Lines

1. On a coordinate grid, graph the following pairs of lines
   a. $y = -\frac{3}{4}x + 5$ and $y = \frac{4}{3}x + 1$.
   b. $y = 3x - 1$ and $y = -\frac{1}{3}x - 1$.
   c. $y = -7x + 2$ and $y = \frac{1}{7}x - 3$.
   d. $y = x$ and $y = -x - 8$

   Do these lines intersect? If so, describe the angles formed at their intersection. Use a protractor if necessary. If not, describe the lines.

2. Create two equations that have the same type relationship as the lines in Question 1. Draw the lines on a grid to show this relationship. What characteristics do these lines possess?

3. Will all lines which have these characteristics have the same relationship? If so, prove it. If not, give a counterexample.

4. Use the relationship between slopes of perpendicular lines to answer the following questions.
   a. Line *m* has the equation, $\mathbf{y = \frac{5}{4}x + 1}$. What is the slope of a line perpendicular to Line *m*?

   b. Write the equation of the line perpendicular to $\boldsymbol{y = -2x + 5}$ whose y-intercept is 12.

   c. Write the equation of the line perpendicular to $\boldsymbol{y = \frac{1}{5}x - 6}$ which passes through the point (1, –3).

   d. What is the equation of the line through (0, 5) and (-4, 8) which is perpendicular to the line that passes through (5, 2)?

Geometric Properties on the Plane Task

1. Determine whether Point A lies on the circle whose center is Point C and which contains the Point P(0, 2). Justify your answer mathematically using a graph of the circle.
   a. Point A $\left(1, \sqrt{3}\right)$; Point C(0,0); Point P(0,2)

   b. Point A(5, 3); Point C(3,1); Point P(3, – 1)

   c. Point A(3, 2); Point C(– 1, – 1); Point P(4, –1)

2. Determine the coordinates of a scalene triangle. Support your answer mathematically and justify with a drawing on a coordinate grid.

3. Classify the triangle as scalene, isosceles, or equilateral. Determine if it is also a right triangle. Then find the perimeter and area.
   a. (1, 4), (4, 5), (5, 2)

   b. (0, –2), (0, 2), (4, 0)

   c. (0, 0), (2, 0), (4, –3)

4. Find the following information for each set of points below.
   a. Plot points and connect to form a quadrilateral.
   b. Determine whether the quadrilateral is a trapezoid, kite, parallelogram, rhombus, rectangle, or square. Justify with math.
   c. Find the midpoints of the diagonals. What do you notice?
   d. Find the slope of the diagonals. Are the diagonals perpendicular?
   e. Find the perimeter of each.

   Set 1: A = (–3, –1), B = (–1, 2), C = (4, 2), and D = (2, –1).

   Set 2: E = (1, 2), F = (2, 5), G = (4, 3) and H = (5, 6).

5. Plot points $A = (1, 0)$, $B = (-1, 2)$, and $C = (2, 5)$.
   a. Find the coordinates of a fourth point D that would make $ABCD$ a rectangle. Justify that $ABCD$ is a rectangle.

   b. Find the area of the rectangle.

Euler's Village Performance Task

You would like to build a house close to the village of Euler. There is a beautiful town square in the village, and the road you would like to build your house on begins right at the town square.

The road follows an approximately north east direction as you leave town and continues for 3,000 feet. It passes right by a large shade tree located approximately 200 yards east and 300 yards north of the town square. There is a stretch of the road, between 300 and 1200 yards to the east of town, which currently has no houses. This stretch of road is where you would like to locate your house. Building restrictions require all houses sit parallel to the road. All water supplies are linked to town wells and the closest well to this part of the road is 500 yards east and 1200 yards north of the town square.

1. How far from the well would it be if the house was located on the road 300 yards east of town? 500 yards east of town? 1,000 yards east of town? 1,200 yards east of town? (For the sake of calculations, do not consider how far the house is from the road, just use the road to make calculations)

2. The cost of the piping leading from the well to the house is a major concern. Where should you locate your house in order to have the shortest distance to the well? (*Remember: the shortest distance between a line and a point is the length of the segment perpendicular to the line that passes through the point*). Justify your answer mathematically.

3. If the cost of laying pipes is $22.50 per linear yard, how much will it cost to connect your house to the well?

4. You also want to install a swimming pool on the line with the pipes. You want the front edge of the pool to be $\frac{3}{5}$ the distance from the road to the well. What are the coordinates of the front corner of the swimming pool?

5. The builder of your house is impressed by your calculations and wants to use the same method for placing other houses. Describe the method you used. Would you want him to place the other houses in the same manner?

6. Write a formula that the builder could use to find the cost of laying pipes to any house along this road. How would you have to change your formula for another road?